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# Peripheral Vegetation of Westernport Bay

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Abstract: Salt marsh vegetation of Westernport Bay can be classified into ten complexes, each composed of one or more communities, linked by structural and floristic similarities. Although these may be ranked in a sea-land sequence, minor changes in topography usually produce a mosaic effect.

Communities dominated by *Arthrocnemum arbusculum* and *Salicornia quinqueflora* cover the largest area of salt marsh vegetation. It is suggested that much of the salt marsh around the shore of Westernport Bay is in a fairly stable state, and that few dynamic changes are occurring.

## INTRODUCTION

During the period 1973–4 an extensive survey of the peripheral vegetation (salt marsh) of Westernport Bay was undertaken. Sampling methods used were those described in Bridgewater (1971). Collected data were processed using computer programmes Zumont/Sort and Zumont/Print, which simulate the process of the Zurich-Montpellier system of phytosociology. A total of 430 releves were collected, using 5m x 5m as the releve area.

Because of the large number of vegetation samples taken in the survey, a classification scheme has been devised along the lines of the scheme proposed by de Smidt (1966) for the heathlands of the Netherlands. This enables all the variation in vegetation from a limited area such as the Bay to be expressed within a classification scheme, without prejudice to the later inclusion of the material in a geographically wider survey.

De Smidt's classification has, as the highest level, the **complex,** a group of **communities** linked by floristic and structural attributes. The **community** is the base level in the classification, although at the extremes of its range there may be **sub-communities** and **variants,** distinguished by floristic attributes.

Salt marshes are characterised by a similarity in vegetation structure (in similar climatic zones) and also a degree of floristic resemblance, usually at the generic level (e.g. genera such as *Salicornia, Arthrocnemum, Suaeda, Samolus, Triglochin*). Thus, all Australian salt marshes are vicariants of plant communities found elsewhere in the world. Australasian marshes can be distinguished by some species being peculiarly Australasian in distribution, e.g. *Selliera radicans, Wilsonia* spp.

The complexes, described in detail in the next section, are listed below with their vicariants:

1. *Avicennia* complex (= Avicennion resiniferae, Chapman 1970).
2. *Spartina* complex (= Spartinion Beeftink 1968).
3. *Salicornia* complex (vicariant of Salicornion Beeftink 1968).
4. *Arthrocnemum* complex (possibly also Salicornion vicariant).
5. *Suaeda* complex (possibly also Salicornion vicariant).
6. *Puccinellia* complex (vicariant of Puccinellion Beeftink 1968).
7. *Juncus* complex (vicariant of Juncetea maritimi).
8. *Stipa* complex (vicariant of Juncetea maritimi).
9. *Schoenus-Cotula* complex (analogous to nano-Cyperion).
10. *Melaleuca* complex (Australian).

These 10 complexes are ranked in an idealized sea-land order, although changes in altitude or slope in a salt marsh may well produce a mosaic vegetation pattern. The Appendix lists the communities and sub-communities within each of the complexes.

To try to judge the contribution of each community to the vegetation of the Bay, 11 regions, of more or less equal size and character were created (Fig. 1). Using these divisions, a table showing the distribution of sub-communities has been plotted (Table 1).

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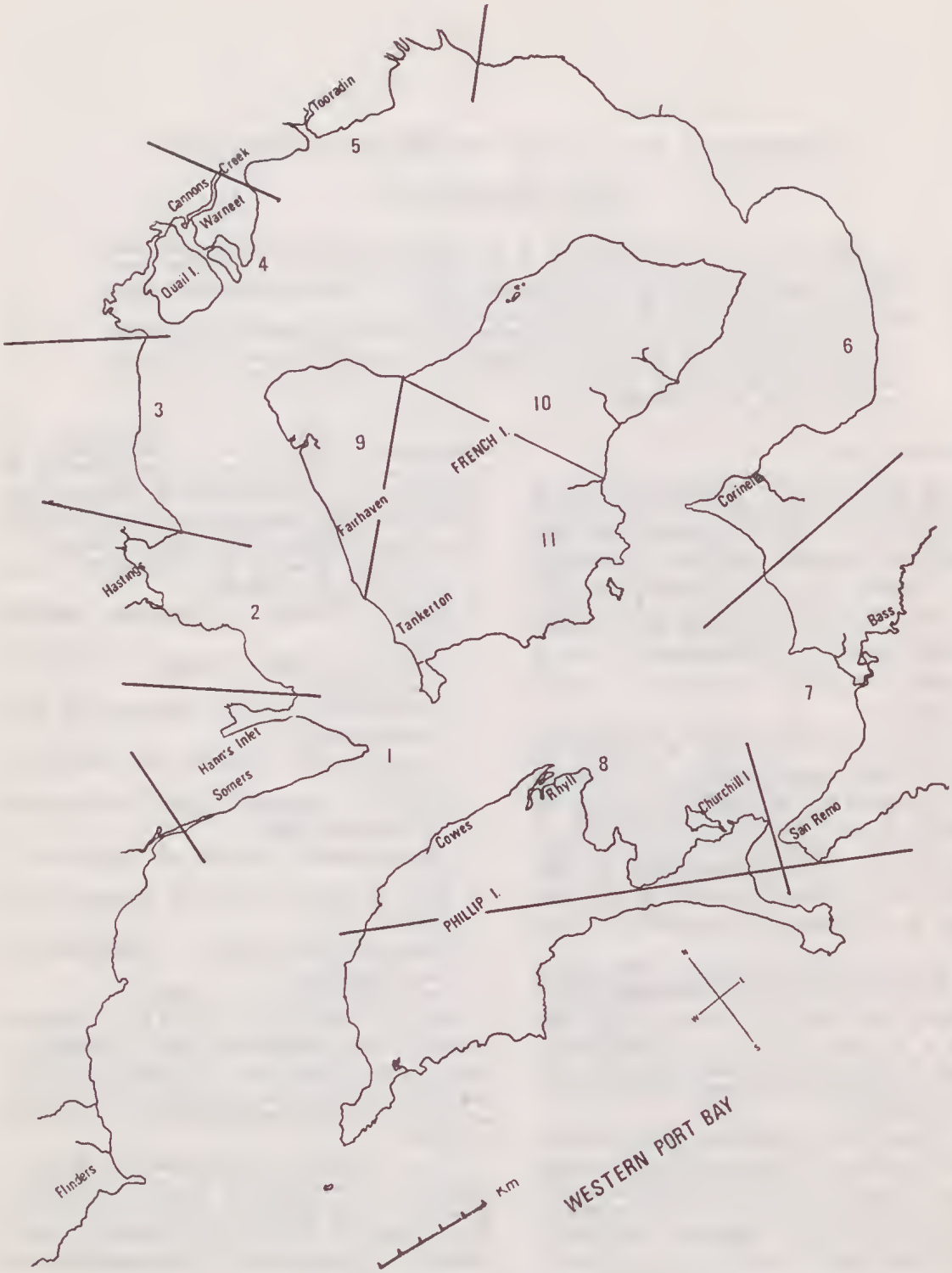
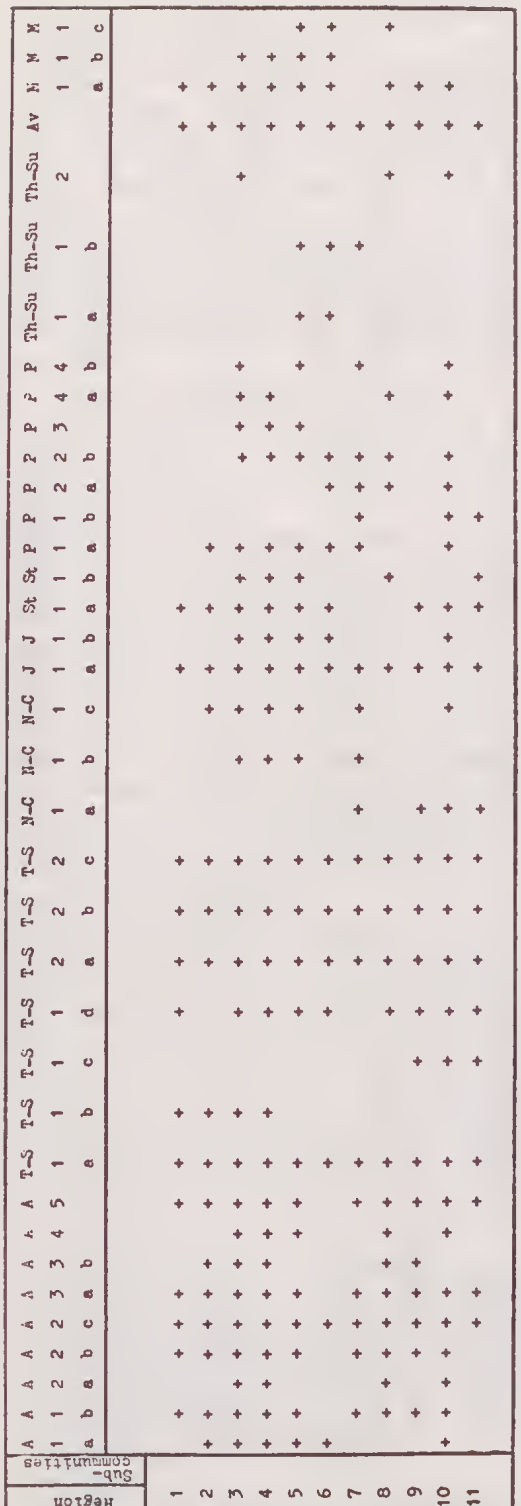



FIG. 1—Westernport Bay, showing regional divisions used in geographical analysis of sub-communities.

TABLE 1

*Geographical Distribution of Salt Marsh Sub-Communities, Westernport Bay, Victoria.*




Many of these are widespread around the shores of the Bay, and individual sub-communities are discussed in detail in the next section. It is interesting to note that the regions with the largest number of sub-communities are 3, 4, 5 and 10 (75%-85% of the sub-communities). Populations of the more restricted species, e.g. *Frankenia pauciflora, Wilsonia backhousei, W. humilis, Salicornia blackiana* are also restricted to this area.

Thus the geographic area from Tyabb to Tooradin, with the north coast of French Island, is the focus of botanical importance in Westernport Bay.

## THE PLANT COMMUNITIES

Table 2 lists the sub-communities, and their identifying species. Full tables for the communities are included in Bridgewater and Hughes (1974). For clarity, the complexes and communities are treated in the order given in the Appendix.

1. *Avicennia* complex (Av.)

Av.1. *Avicennia marina* community.

Chapman (1970) includes all Australasian mangrove communities in the Avicennietum resiniferae. Because the species *A. marina* is normally distinguished as var. *resinifera* in Australia and New Zealand he maintains this distinction at community level, to distinguish the Australasian vegetation.

The distribution of the community is all round the Bay, but concentrated in the north west of the Bay, and the mouth of Bass River.

There seems little doubt that the *Avicennia* populations in Victoria are relict in origin, and that they are on the fringe of their range.

2. *Spartina* complex (Sp.)

Sp.1. *Spartina x. townsendii* community.

As an introduced species, this community is synonymous with the Spartinetum of W. Europe (Beeftink 1968).

Found at the mouth of Bass River, Main Drain outlet, and possibly in some other localities. Also at Andersons Inlet, Victoria. In the pure form, the community is not very common, becoming established on bare mud patches in the absence of *Avicennia* plants. A wide range of *Salicornia* communities, however, do have a content of *Spartina,* which appears to be invading.

3. *Salicornia* complex (T-S)

T-S.1. *Triglochin striata* community.

Found alongside creeks and mud flats, this community is subject to regular tidal submersion at the seaward edge of the marsh. The *Schoenus nitens* sub-community is an exception, being found only on the west coast of French Island,

## TABLE 2

*Presence table for identifying species in communities and sub-communities*

| | Av | S | T–S | | | T–S | | | A | | A | | | A | A | A | Th–Su | | | P | | P | | P | P | J | | | St | N–C | | | M | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 1a | 1b | 1c | 1d | 2a | 2b | 2c | 1a | 1b | 2a | 2b | 2c | 3a | 3b | 4 | 5 | 1a | 1b | 1c | 2 | 1a | 1b | 2a | 2b | 3 | 4a | 4b | 1a | 1b | 1c | 1 | 1a | 1b | 1c | 1a | 1b | 1c |
| SPECIES COMMON TO ALL COMPLEXES: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Samolus repens | | | V | 2 | 4 | III | | | | V | V | V | V | V | III | V | II | IV | | | 1 | | III | IV | IV | V | II | V | | V | IV | III | III | I | 4 | II | V | II | |
| Salicornia quinqueflora | [+] | [+] | V | 3 | 4 | V | V | V | 4 | V | V | V | IV | V | IV | V | V | V | 1 | 1 | 1 | | V | V | V | V | V | V | IV | IV | V | IV | IV | V | 4 | III | | | |
| IDENTIFYING SPECIES OF THE COMPLEXES: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Avicennia marina | V | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spartina x. townsendii | | V | | | | | + | | | | | | | | | | | + | | | | | | | | | | | | | | | | | | | | | |
| Triglochin striata | | | V | 4 | 4 | V | | | 1 | V | | V | V | V | + | | I | + | | | | | I | I | V | V | I | II | | I | II | I | | II | I | | I | |
| Arthrocnemum arbusculum | | | V | | | + | | | | V | V | V | V | V | V | V | V | V | | | | 3 | | | | | | | | | | | I | | | | | | |
| Suaeda australis | | | + | | 1 | I | | V | 2 | III | III | IV | | V | IV | V | V | IV | IV | 4 | 3 | 3 | II | II | IV | II | III | III | II | II | II | II | I | II | | II | I | | II | |
| Hemichroa pentandra | | | V | 1 | 1 | I | | | | IV | IV | III | | V | V | II | V | III | III | | | | II | II | I | IV | I | | | II | II | I | I | | | I | | | |
| Rhizoclonium sp. | | | | | | | | | | IV | II | IV | IV | IV | IV | V | III | IV | | | | | | | I | | II | | I | | II | I | I | | | | | | |
| Puccinellia stricta | | | | | | | | | | V | V | | | + | | | | | | | | | V | V | V | V | II | | | | | | | 1 | | | | | |
| Disphyma australe | | | | 3 | 1 | | | | | III | II | I | | II | I | I | III | + | | | | | IV | V | III | II | IV | V | V | III | III | II | III | I | 2 | IV | III | IV | III |
| Juncus maritimus | | | + | | | | | | | | I | | II | II | | | | | | | | | + | I | + | | II | | | V | V | V | | | | | | | |
| Salicornia teretifolia | | | | | | | | | | | + | + | II | II | + | I | V | + | | | | | + | I | | | I | | | V | + | | V | | 1 | | I | | |
| Schoenus nitens | | | | | 4 | | | | 1 | | | | | | | | | | | | | | I | I | I | I | I | I | | | + | I | | V | 4 | IV | II | | I |
| Cotula coronopifolia | | | | | | | | | | | | | | | | | | | | | | | I | III | + | I | | | | | + | I | | III | 4 | IV | | | |
| Sporobolus virginicus | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | I | + | I | I | II | | I | II | | | IV | 2 | V | | | |
| Parapholis incurva | | | | | 2 | | + | | 2 | I | + | | | | | | | | | | | | | V | II | II | II | II | III | I | I | II | | III | 4 | V | I | II | |
| Agrostis billardieri | | | | | | | | | | + | + | | | | | | | | | | | | II | I | + | II | I | | I | | | | I | III | 2 | V | I | II | |
| Melaleuca ericifolia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | V | V | V |
| IDENTIFYING SPECIES OF THE COMMUNITY AND SUB-COMMUNITY: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Selliera radicans | | | | 4 | 1 | | | | | I | + | | | IV | | | II | | | | | | II | III | + | II | III | I | III | IV | | I | | II | V | I | I | |
| Distichlis distichophylla | | | + | | | | | | 1 | I | III | | III | V | | V | III | + | | | | | III | IV | | V | | IV | IV | IV | | IV | | | V | V | | | |
| Limonium australe | | | | | | | | | | + | | | V | I | + | III | | I | | | | | | | | | | | | | | | | | | | | I | I |
| Atriplex paludosa | | | | | | | | | | I | + | II | II | II | V | V | III | | | | 3 | 1 | | | | | | | I | I | I | I | | | | | | | |
| A. hastata | | | | | | | | | | | | | | | + | | | | 4 | | | | | | + | | II | I | | | | | II | 1 | II | I | | III |
| A. cinerea | | | | | | | | | | | | | | | + | | | | 1 | 2 | | | | | | | | | | | | | | | | | | | |
| Plantago coronopus | | | | | | | | | | | | | | | | | | | | | | | | I | | | | IV | I | I | | I | I | 1 | II | I | | |
| Frankenia pauciflora | | | | | | | | | | | | | | | | | I | | | | | | | | | V | | | | | | | | 4 | | | | |
| Sebaea albidiflora | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | I | 4 | II | | |
| Anglianthus preissianus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | I | I | |
| Lophocolea semiteres | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | III | |
| Scirpus nodosus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | I | I | I | III | | | | I | IV | I |
| Senecio lautus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | II | + | II | I | | II | | IV | | |
| Tetragonia tetragonioides | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | IV |

Presence classes: + — species occurs in only one releve
I — species occurs in 1-20% of releves
II — „ „ „ 21-40% „ „
III — „ „ „ 41-60% „ „
IV — „ „ „ 61-80% „ „
V — „ „ „ 81-100% „ „

Where arabic numerals are used, the number of releves used to form the sub-community is less than five, and the numbers refer to the actual number of occurrences.

and on the inland side of the marsh. However, there has been considerable disturbance from cattle trampling in this area. Where the ground rises slightly, scattered plants of *Arthrocnemum arbusculum* occur, forming the *A. arbusculum* sub-community, which links the *Salicornia* complex with the *Arthrocnemum* complex, via the *Arthrocnemum-Triglochin* community (A.2.).

Open flat areas that are submerged by the tide sometimes have dense mats of *Selliera radicans* with *Triglochin striata* and *Salicornia quinqueflora*, forming the *Selliera radicans* sub-community. This is most frequent in the Warneet-Crib Point area of coastline.

T-S.2. *Salicornia quinqueflora* community.

This community forms the most seaward of salt marsh vegetation, immediately behind the *Avicennia* community, or, occasionally without any preceding *Avicennia*.

Additionally, this community is found in areas on the landward side of the marsh that are lower than the rest of the marsh, and accumulate water (particularly in winter) on the silt surface. This water is either overflow from king tides, or, more usually, drainage from the hinterland. A major feature of the typical sub-community is an almost total lack of other species, apart from *Salicornia quinqueflora*. At sites between Tyabb and Tooradin *S. blackiana* sometimes occurs mixed with *S. quinqueflora*, at the landward edge of the marsh. *S. blackiana* is fairly uncommon as a coastal species, although it has a number of occurrences in Port Phillip Bay.

The SE. coasts of Westernport Bay and French Island have a larger area of the *S. quinqueflora* community than other parts of the Bay. Also, large amounts of *Zostera* detritus are washed onto the marsh in this area. (Sometimes 30-40 cm deep.) In these conditions the *Suaeda australis* sub-community develops, with a *Rhizoclonium* (a green alga) variant where the *Zostera* deposit is not very thick. *Rhizoclonium* forms a dense tangled skein beneath the *Salicornia* and *Suaeda*, which is characteristic of this variant, and the following sub-community.

In more sheltered areas, almost exclusively in the SE. of French Island, the *Hemichroa pentandra* sub-community is common. It is, however, one of the most restricted forms of salt marsh vegetation encountered in the survey.

4. *Arthrocnemum* complex

A.1. *Arthrocnemum-Puccinellia stricta* community.

Found most frequently on the landward side of the marsh system—often grading into communities of the *Puccinellia* complex. Clearly this community is very much a transition form of vegetation, between more typical *Arthrocnemum* communities and *Puccinellia* communities. Usually low cover/abundance values for *Arthrocnemum*, further underline the vegetation's transitional nature. The two sub-communities, and the *Distichlis distichophylla* variant of the typical, form a wet-drier gradient. Extreme wet forms of the vegetation are found bordering brackish pools, on the landward side of the marsh.

Although useful to consider this as a 'community' in the context of the Bay salt marsh, it would certainly not be maintained as an association in a wider survey. It serves to emphasize, however, the difference between sharp boundaries such as that between the *Avicennia* community and *Salicornia* community, and gradual transition zones.

A.2. *Arthrocnemum-Triglochin striata* community.

Vegetation from this community occupies the position between *Salicornia* communities and other *Arthrocnemum* communities (e.g. A.3. and A.5.). Its structure and diversity varies with the breadth of salt marsh, and tidal influences.

Where the sea invades via creeks there is often a wide range of variants from this association—particularly where it impinges on *Juncus maritimus* communities. This is the seaward analogue to A.1. Like A.1., sub-communities other than the typical often have rather low values for *Arthrocnemum* on cover/abundance scales.

Where the expanse of marsh inundated by tides is large, a *Limonium australe* sub-community develops. There is some overlap between this sub-community and the *Distichlis distichophylla* sub-community, by a *Distichlis variant* (A.2.b.1.). The greatest variation is found, however, in the *Selliera radicans* variant of the *Distichlis* sub-community (A.2.c.1.). Here the conditions vary between long immersion under sea water (close to creek sides) and relatively short immersion. There is a complex series of sub-variants, all illustrating the very 'fuzzy' nature of vegetation boundaries in this zone.

The *Wilsonia backhousei* sub-variant is different from the others, because it forms quite large areas of marsh in localities such as Cannons Creek, Yaringa, Chinaman and Quail Islands. This is analagous to, and often mixed with, vegetation of T-S.2.c. Both these vegetation units occur in areas that are submerged at high tide, but for only relatively short periods.

A.3. *Arthrocnemum-Atriplex paludosa* community.

This community represents the typical form of the *Arthrocnemum* complex, growing on drier,

usually raised, areas of the marsh. Drier sites support a typical sub-community, with relatively few species (including low presence values for both *Samolus repens* [56% of releves] and *Hemichroa pentandra* [25% of releves]) whilst slightly wetter areas support a *Distichlis distlichophylla* sub-community (transitional to the *Distichlis distichophylla* sub-community for A.2.). *Atriplex paludosa* exhibits a climbing growth form (over *Arthrocnemum* bushes) in this vegetation.

A.4. *Arthrocnemum-Stipa teretifolia* community.

*Stipa teretifolia* is usually associated with dry, often sandy, areas of the marsh, although it can grow with *Juncus maritimus* in areas that are submerged. In this (A.4.) community, it occurs as a dominant, or co-dominant plant in the driest (and often highest) parts of the *Arthrocnemum* vegetation. Because of the dependance on differences in edaphic factors, this community usually occurs as patches among other *Arthrocnemum* communities (notably A.3. and A.5.). A species often associated with this community is *Gahnia filum*—which also occurs as occasional scattered tufts throughout a wide range of communities.

A.5. *Arthrocnemum-Suaeda australis* community.

This is the 'typical' community of the complex, and is quite species poor in contrast to some others. In drier areas species richness declines further—particularly with loss of *Hemichroa pentandra* from a number of sites. *Arthrocnemum* reaches its best development in this community, usually covering > 60% of surface area. *Arthrocnemum* is remarkable also for the number of epiphytes it carries, including a number of lichens and the moss *Tortula papillosa.*

In areas where large quantities of *Zostera* fragments are deposited, a depauperate version of the community, involving only the shrubs *A. arbusculum, Suaeda australis,* and *Salicornia quinqueflora* is found. This is linked to the *Suaeda* complex, floristically and structurally.

5. *Suaeda* complex (Th-Su)

There are two communities within this complex, which can also be distinguished by the lack of the species *Salicornia quinqueflora* and *Samolus repens,* both of which can be regarded as ubiquitous throughout all other communities.

Th-Su.1. *Suaeda australis* community.

The community occurs on strand lines, mainly in areas that lack full salt marsh development. They are not, therefore, part of the interrelated system of salt marsh communities. The *A. hastata* sub-community occurs where there is no salt marsh littoral fringe (the presence of *Phragmites communis* in two releves illustrates the oligohaline environment of this sub-community). The *A. cinerea* sub-community appears localized in the large saltings at the mouth of Bass River.

Th-Su.2. *Arthrocnemum arbusculum* community.

This community is formed by three releves only, although they are from widely separated parts of the Bay. The main feature is the dominance of *Arthrocnemum arbusculum,* and the almost total lack of any other species. In two cases a massive deposit of *Zostera* detritus may serve to prevent other species from becoming established. At Palmers Point, French Island, a deep drain has meant mud dries out very rapidly, and conditions are probably unsuitable for the establishment of other species—and the rather dry conditions may have forced the loss of species in the first place.

6. *Puccinellia* complex (P)

P.1. *Puccinellia stricta* community.

Although Bay-wide in distribution, the largest areas of this community, and indeed, the complex, are at Bass River, Rhyll, and the north coast of French Island. A *Parapholis* sub-community is confined to the Bass River and French Island localities. *Puccinellia* communities occupy the landward side of the marsh behind the *Arthrocnemum* zone. Their abundance in the Bass River and French Island sites is due to cattle grazing. This is extremely beneficial, as it tends to increase and maintain species diversity. *Puccinellia, Agrostis billardieri* and *Parapholis incurva* are the main grasses eaten. *Juncus revolutus* is not uncommon in these *Puccinellia* communities, and is almost certainly maintained by grazing pressure. *Parapholis incurva* is an introduced grass from Europe, and curiously enough is a character species for the European alliance Puccinellion. In fact, vegetation of the *Puccinellia* complex is rather poor in grasses, and has abundant *Salicornia,* which suggests an Australian analogue to the Puccinellion may not exist—the vegetation being an ecological variant of the alliance Salicornion. Further work should clarify this situation, with releves from a wider area. Both the *Parapholis* sub-community, and the *Agrostis billardieri* variant of the typical sub-community are from drier localities—although *Puccinellia stricta* does not appear to be affected by standing water.

P.2. *Puccinellia-Triglochin striata* community.

Just as community A.1.a. occupied a transition area between *Puccinellia* and *Arthrocnemum* communities, this community is intermediate between the *Puccinellia* (P.1.) community and open pools, with *Ruppia maritima* and the alga *Lamprothamnium papulosum.*

The wettest areas of the *Distichlis distichophylla* sub-community have a variant with the following differential species: *Selliera radicans, Hemichroa pentandra.* Vegetation of the landward

side of salt marshes, with pools, is therefore a complex mixture or mosaic of communities A.1., P.1. and P.2.

P.3. *Frankenia pauciflora* community.

This community is restricted both ecologically and geographically. Although described here as a separate community, it may be only a phase of the *Salicornia community*—and most certainly it is a transition between the *Salicornia* community and the *Schoenus-Cotula* community.

A point of interest is the occurrence of *Salicornia blackiana* in some of the releves collected, a species whose range is as narrow as *Frankenia pauciflora,* within the Bay area.

P.4. *Disphyma australe* community.

Drier, often disturbed parts of the marsh support this community. Despite a lack of *Puccinellia stricta,* vegetation of this community is contiguous with, and sometimes forms a mosaic with, *Puccinellia* communities. Where there has been disturbance a *Plantago coronopus* sub-community develops. There is often a higher percentage of sand in the soil from these areas than sites of the other *Puccinellia* communities. In extreme forms, this community has very few species, but has *Disphyma* dominant.

7. *Juncus* complex (J)

J.1. *Juncus maritimus* community.

Occurring on the tidal side of *Arthrocnemum* communities, and on the extreme landward side of the marsh. This community is an Australian vicariant of the Juncetea maritimi vegetation from Europe.

Following the pattern of most salt marsh vegetation, the identifying species (*J. maritimus*) is also the dominant one. Boundaries between the *Juncus* community and others are usually sharp.

In some places, possibly due to the influence of fresh water through flow, a number of mesophytes can be found, e.g. *Mimulus repens, Lythrum hyssopifolia, Senecio lautus,* as component species. Certainly, this vegetation is among the most variable in 'chance' species.

8. *Stipa* complex (St.)

St.1. *Stipa teretifolia* community.

The community occurs on sandy banks around the Bay and other localities in eastern Victoria. Also found on sand deposits amongst other marsh vegetation. Naturally there is some overlap between this community and A.4. This community, however, occurs only on dry sites, with A.4. occupying damper, and even wet sites.

9. *Schoenus-Cotula* complex (N-C)

N-C.1. *Schoenus nitens-Cotula coronopifolia* community.

As the most landward vegetation of the salt marsh 'proper', it is not surprising that this community is richest in species, especially grasses and herbaceous plants. Unlike *Puccinellia* communities, cattle grazing does tend to reduce the species richness, perhaps because the *Melaleuca* community (q.v.) is often totally removed—or at least partially destroyed, in such sites.

Some of the differential species and accompanying species of the sub-communities are ephemeral plants, e.g. *Angianthus preissianus, Apium prostratum, Sebaea, albidiflora, Juncus bufonis.*

Although there is a *Distichlis Distichophylla* sub-community the morphologically similar grass *Sporobolus virginicus* is the dominant feature of the community. Rabbit grazing appears to be an important factor in preventing succession in this community. It occupies a position analogous to that of halophytic associations of nano-Cyperion in Europe, which are found on the landward side of salt marshes.

10. *Melaleuca* complex (M)

M.1. *Melaleuca ericifolia* community.

This community is less a community than a boundary zone, or ecotone, between salt marsh and wooded heathland on sandy soils. A very varied vegetation is the result—analogous to the German Saum or 'Mantle' communities. These are associated with woodland edges: usually sharp edges with fields, i.e. anthropogenic effects. This salt marsh/woodland boundary is similarly sharp, but the factors are all naturally induced.

*Melaleuca ericifolia* is this boundary species between woodland and salt marsh around much of the south-east coast of Australia. Despite this, the species content of this community depends very much on the hinterland.

## PLANT COMMUNITY RELATIONSHIPS IN SPACE AND TIME

Spatial and temporal arrangements of vegetation are often confused by authors, temporal 'possibilities' being extrapolated from spatial actualities (e.g. Chapman 1960). Three 'schema' of spatial arrangements are shown in Fig. 2. A diagram suggesting possible dynamic relationships is shown in Fig. 3.

Beeftink (1966) makes much of a 'cybernetic approach' to salt marsh ecology. This approach is particularly valuable when discussing the Westernport coastal system. Beeftink points out the combination of unstable and stable factors which characterize a coastal system, e.g. regularity of tidal fluctuations is a stable character, salt-spray on landward vegetation and flooding of creeks are unstable characters. Van Leeuwen (1966) distinguishes two vegetation types in terms of stability:

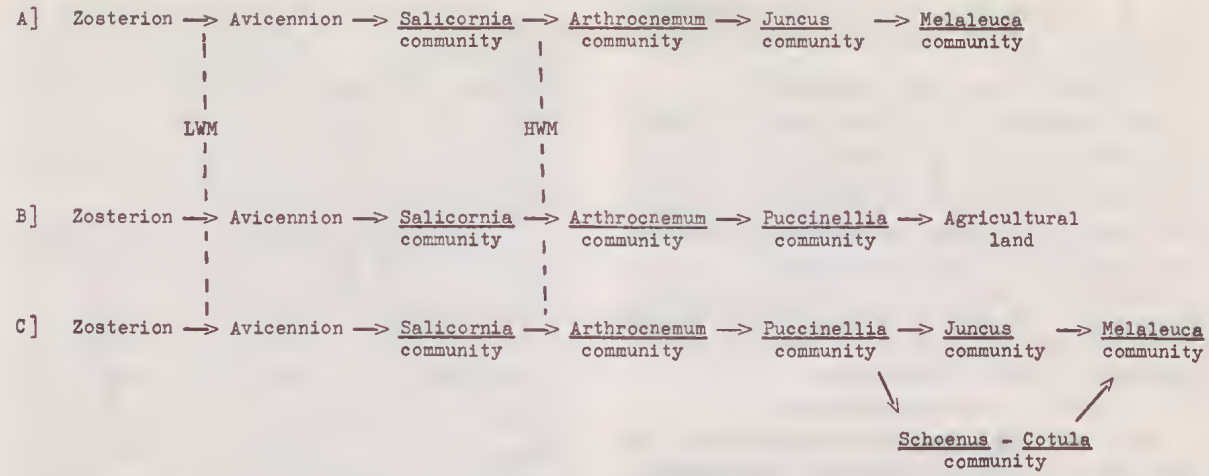



FIG. 2—Possible spatial arrangements of salt marsh communities.

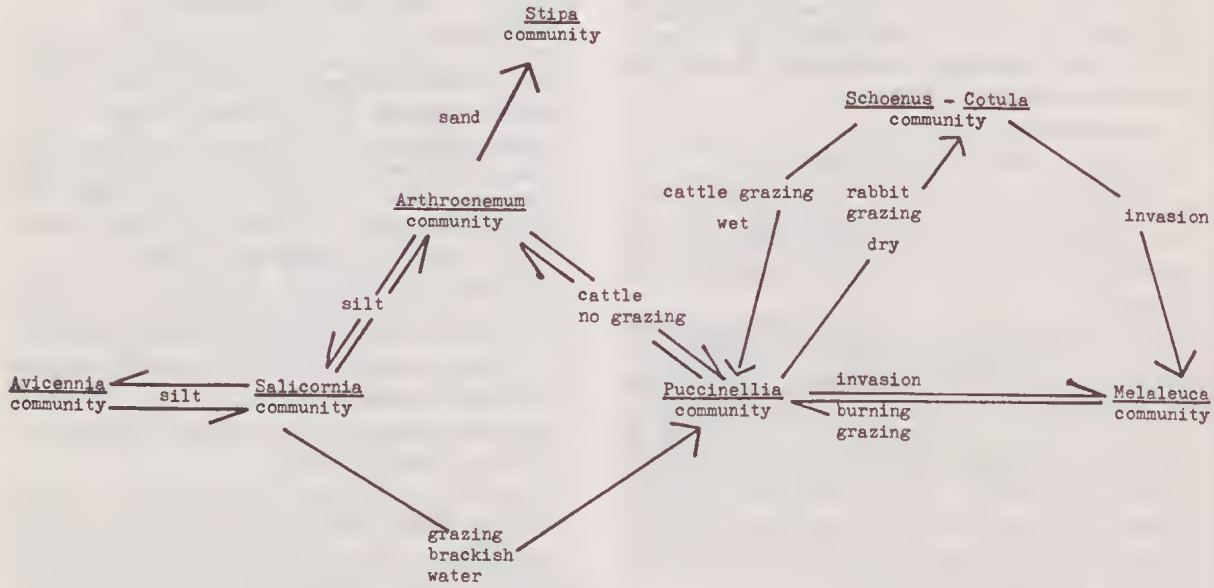



FIG. 3—Possible dynamic relationships between salt marsh communities.

(a) *unstable* vegetation has coarse grained patterns, is poor in species, and has sharp boundaries with neighbouring vegetation (e.g. *Salicornia* community).
(b) *stable* vegetation has a fine grained pattern, is rich in species, and has vague boundaries with neighbouring vegetation (e.g. *Schoenus nitens-Cotula coronopifolia* community).

In general, then, the more landward vegetation possesses stable characters, whereas the seaward vegetation may be regarded as unstable.

Expanding this theme to looking at the coastal land system as a whole, then those areas of coast with the greatest variety of plant communities are likely to be more stable than those with little variety. In the former case, there is a range of communities, usually with vague boundaries between them, and thus this satisfies the 'high

variety-in-space' versus 'low variety-in-time' criterion of van Leeuwen. It would seem to follow that the areas of coastline with the largest variety-in-space offer the best chance for conservation. Such areas would include the coast from Tyabb to Tooradin, the north coast of French Island and Rhyll Swamp.

## ACKNOWLEDGMENTS

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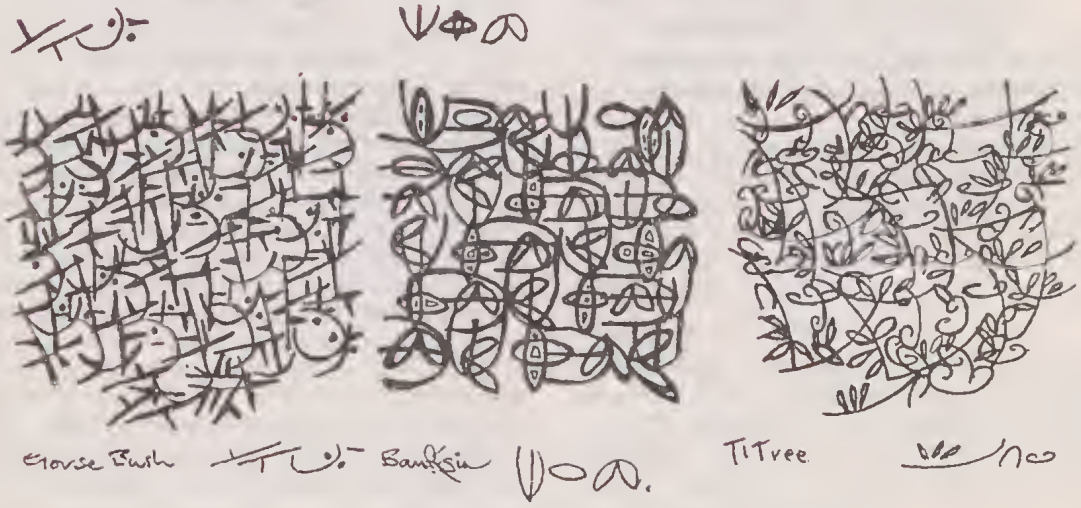


*Notation Drawings*

APPENDIX

## LIST OF VEGETATION UNITS

Av. *Avicennia* complex
- Av.1. *Avicennia marina* community.

S. *Spartina* complex
- S.1. *Spartina x. townsendii* community.

T-S. *Salicornia* complex
- T-S.1. *Triglochin striata* community.
  - T-S.1.a. *Arthrocnemum arbusculum* sub-community.
  - T-S.1.b. *Selliera radicans* sub-community.
  - T-S.1.c. *Schoenus nitens* sub-community.
  - T-S.1.d. typical sub-community.
    - T-S.1.d.1. *Avicennia* phase.
- T-S.2. *Salicornia quinqueflora* community.
  - T-S.2.a. typical sub-community.
    - T-S.2.a.1. *Avicennia* phase.
  - T-S.2.b. *Suaeda australis* sub-community.
    - T-S.2.b.1. *Rhizoclonium* variant.
  - T-S.2.c. *Hemichroa pentandra* sub-community.

A. *Arthrocnemum* complex
- A.1. *Arthrocnemum-Puccinellia stricta* community.
  - A.1.a. typical sub-community.
    - A.1.a.1. *Distichlis distichophylla* variant.
  - A.1.b. *Triglochin striata* sub-community.
- A.2. *Arthrocnemum-Triglochin striata* community.
  - A.2.a. typical sub-community.
  - A.2.b. *Limonium australe* sub-community.
    - A.2.b.1. *Distichlis distichophylla* variant.
  - A.2.c. *Distichlis distichophylla* sub-community.
    - A.2.c.1. *Selliera radicans* variant.
      - α *Juncus maritimus* sub-variant.
      - β *Juncus-Atriplex* sub-variant.
      - γ *Atriplex paludosa* sub-variant.
      - σ *Wilsonia backhousei* sub-variant.
- A.3. *Arthrocnemum-Atriplex paludosa* community.
  - A.3.a. typical sub-community.
  - A.3.b. *Distichlis distichophylla* sub-community.
- A.4. *Arthrocnemum-Stipa teretifolia* community.
- A.5. *Arthrocnemum-Suaeda australis* community.

Th-Su. *Suaeda* complex
- Th-Su.1. *Suaeda australis* community.
  - Th-Su.1.a. *Atriplex hastata* sub-community.
  - Th-Su.1.b. *A. paludosa* sub-community.
  - Th-Su.1.c. typical sub-community.
- Th-Su.2. *Arthrocnemum arbusculum* community.

P. *Puccinellia* complex
- P.1. *Puccinellia stricta* community.
  - P.1.a. typical sub-community.
    - P.1.a.1. *Agrostis billardieri* variant.
  - P.1.b. *Parapholis incurva* sub-community.
- P.2. *Puccinellia-Triglochin striata* community.
  - P.2.a. typical sub-community.
  - P.2.b. *Distichlis distichophylla* sub-community.
    - P.2.b.1. *Selliera radicans* variant.
- P.3. *Frankenia pauciflora* community.
- P.4. *Disphyma australe* community.
  - P.4a. *Samolus repens* sub-community.
  - P.4.b. *Plantago coronopus* sub-community.

J. *Juncus maritimus* community
- J.1. *Distichlis distichophylla* community.
  - J.1.a. *Selliera radicans* sub-community.
  - J.1.b. *Stipa teretifolia* sub-community.
  - J.1.c. typical sub-community.

St. *Stipa* complex
- St.1. *Stipa teretifolia* community.

N-C. *Schoenus-Cotula* complex
- N-C.1. *Schoenus nitens-Cotula coronopifolia* community.
  - N-C.1.a. typical.
  - N-C.1.b. *Frankenia pauciflora* sub-community.
  - N-C.1.c. *Distichlis distichophylla* sub-community.

M. *Melaleuca* complex
- M.1. *Melaleuca ericifolia* community.
  - M.1.a. *Distichlis distichophylla* phase.
  - M.1.b. *Lophocolea semiteres* phase.
  - M.1.c. *Scirpus nodosus* phase.